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AUTHOR Gregory, John W.; Casteel, J. Doyle
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ABSTRACT

The purpose of this study was to extend the research of the first-named author into the effect of teachers' use of conditional language on students' growth in logical thinking. Verbal behaviors of nine mathematics teachers and four social studies teachers were coded and correlated with the gain scores of their eighth-grade students on the Cornell Conditional Reasoning Test. A Positive correlation (.39) was found between mathematics teachers' use of conditional language and students' score changes; no such correlation was observed for social studies teachers. Correlations between the frequency of conditional moves by the teacher and other classroom verbal factors were computed as were correlations between average class gain and classroom verbal factors. Hypotheses concerning the results obtained are discussed. (SD)

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Verbal Environment Correlates With Student Growth in Logical Reasoning Ability*

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John W. Gregory and J. Doyle Casteel
Department of Secondary Education
Institute for Development of Human Resources
College of Education
University of Florida

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Introduction

This study is one in a sequence of studies being conducted at the University of Florida in a program of research on teacher effectiveness. Of central concern for this investigation was the relationship between growth in conditional reasoning ability of eighth grade mathematics and social studies students and the verbal behaviors of teachers and students in the interactive environment of instruction.

Rationale

There have been studies to date which indicate that the utilization of the language of formal logic in verbally mediated instruction is correlated with student achievement, student growth in logical reasoning ability, student recall of relevant information and teacher questioning strategies. Of particular significance for this project, Gregory (1972) reported that a positive correlation existed between seventh grade student growth in conditional reasoning ability and student membership in a mathematics class in which the teacher used a high frequency of conditional moves. A conditional move is the statement of a premise for which a consequence is to be supplied by students or is stated by the teacher. Typically the linguistic paractigm "If...then..." is used.

It was the purpose of this investigation to determine whether or not the same finding would exist for eighth grade mathematics and social studies students and to determine interactive patterns and teacher verbal strategies which are also related to student growth in conditional reasoning ability.

Method

Eighteen teachers of eighth grade mathematics or eighth grade social studies from ten schools in the Hillsborough County School System and one of their classes were selected to serve in the investigation. The loss of five social studies teachers due to administrative difficulties reduced the sample to four teachers and four classes in social studies and nine teachers and nine classes in mathematics.

The student subjects were administered a shortened form of the Cornell Conditional Reasoning Test in early September and again in early February of the 1973-74 school year. A gain score for each student was computed by regression of posttest performance on pretest performance.

Three lessons presented by each teacher to his respective class in January were coded by two trained reliable observers using the Social Science Observation Record (Casteel, 1973) and Gregory's system for coding conditional moves (Gregory, 1972). The data thus obtained were analyzed to determine the relationship between the teacher's utilization of conditional moves and both the student gain in conditional reasoning ability (point-biserial correlation), and average class regressed gain (product-moment correlation). The measures provided by the SSOR data were related to both the teacher's utilization of conditional moves and average class gain in conditional reasoning ability.

Findings

Membership in mathematics classes in which teachers use high frequencies of conditional moves was found to be related positively

with student growth in conditional reasoning ability (r = .39). A significant relation was not found to exist between these measures in social studies classes. The average frequency of conditional moves by teachers of mathematics was not found to be related to their average class gain in conditional reasoning ability. A significant negative correlation (r = -.90) was found to exist between these two variables in social studies classes. Factors provided by SSOR measures identified as being related to the use of conditional moves by teachers differed for the two content areas. These factors include student verbal behaviors which are characteristic of specific learning types (conceptual, procedural, value clarification, problem solving), components of a theoretical teacher verbal strategy term "hypothetico-deductive structuring", student behaviors sought through teacher questioning and reinforced by the teacher, and teacher response to dysfunctional behaviors associated with dicipline in the classroom. (Table 1).

Factors provided by the SSOR measures were also identified as being related to the average class gain in conditional reasoning ability. Again these factors differed for the two content areas. They include student expressed confusion and insecurity in response to teacher questioning (negative correlation), teacher interruption of student response (negative correlation), teacher utilization of wait-time (positive correlation), and multiple reinforcement (positive correlation). (See Table 2).

Discussion

This investigation was an attempt by the investigators to shed some light on the complexities inherent in the teaching act with concern for the utilization of the language of logic and its function in classroom discourse as well as its relationship to student growth in logical reasoning ability. The discussion which follows should be considered hunches which are consistent with findings of a correlational nature.

Probably of greatest importance is the indication that although the same verbal strategy of teachers may exist and be analyzed in a natural setting (where teachers have no knowledge of its existance nor of its function), its utilization can differ functionally both in terms of the teaching act as well as student outcomes.

The findings suggest that teachers who utilize higher frequencies of the conditional move have lessons in which higher frequencies of verbal behaviors associated with learning types emphasized in professional literature (concept and procedural in math; value clarification in social studies). The mathematics teachers with higher frequencies of conditional moves actively sought and confirmed these behaviors. This was not true for social studies teachers. The data from both content areas does suggest, though, that the utilization of the conditional move aides a teacher in acquiring the desired categorical response from students.

There is evidence that supports an established theoretical structuring model (Hypothetico-Deductive Structuring) reported by the investigators in an earlier paper (1974). It is within the context of this model that

the functioning of the conditional move can best be described. Basically, the model is comprised of a sequence of teacher statements followed by a teacher question. The conditional move enters the model at two points. It introduces the lecture portion of this strategy functioning to cue students to the contextual structure to be presented within which discussion centered. The second point is between the context provided by the teacher and the teacher's question thus serving to link the context to the question. Both the mathematics and social studies teachers using more conditional moves than their respective counterparts used more of the elements associated with this model as offered by the SSOR.

Another major difference is apparent from the data. There is a negative correlation between mathematics teacher utilization of the conditional move and the occurrence of class disruptions (dysfunctional behaviors). This coupled with the finding that behaviors sought and valued by these mathematics teachers were achieved, suggests that the mathematics teachers who use higher frequencies of the conditional move not only controlled the lessons in order to obtain these behaviors, but this order extended to the classroom climate as well. This feature of structure is lacking for the social studies teachers. Since these same dysfunctional behaviors correlate negatively with student gain scores in mathematics classes, their absence in terms of correlates with social studies teachers' use of the conditional move may help explain the negative correlation between the use of conditionals and student gain scores.

In summarizing the findings of this investigation, there are several implications suggested. First, there is something at work between the verbal behaviors of both the mathematics classroom and social studies classroom and student growth in conditional reasoning ability. Since this ability is considered to be basic to other types of logical reasoning ability and subsequently a desirable objective for instruction in all disciplines, investigations which attempt to answer questions brought on by this study should be conducted. These investigations should build upon the correlational evidence which now exists and do so primarily in terms of cause-and-effect relationships. One way in which this might be achieved would be to compare student outcomes in terms of the use of the conditional move by teachers who are trained in its function (and exhibit the function in their teaching) and those who use it naturally without knowing its function. A training program has already been established which achieves the functional utilization of the move (Gregory & Casteel, 1974).

Secondly, there appears to be a negative relationship between those student behaviors social studies teachers are trained to value and student growth in conditional reasoning ability. It would be useful to know if, and the degree to which, the implementation of a conceptual-based social studies curriculum would yield gain scores that correlate with a high frequency of teacher utilization of the elements of the theoretical model. Here, it might be useful to compare the correlates of teachers who use elements of the model naturally and teachers trained to use the skill functionally.

TABLE 1

Significant Relationships* Between Teacher Conditional Move Frequency and Classroom Verbal Factors

Mathematics Lessons (n=27)	
Concept Learning	r=.56
Procedural Learning	r=.41
Student Verbal Behaviors Sought	r=.51
Student Verbal Behaviors Confirmed	r=.49
Hypothetico-Deductive Structuring** Elements	r=.70
Dysfunctional Behavior	r=.51
Student Conditional Moves	r=.40
Social Studies Lessons (n=12)	
Student Verbal Behaviors Sought	r=.79
Student Verbal Behaviors Confirmed	r=.71
Hypothetico-Deductive Structuring Elements	r=.80
Student Conditional Moves	r=.55
Student Value Clarification	r=.67

*$p < .05$

** Defined under "Discussion"

TABLE 2

Significant Relationships* Between Average Class Gain

And Classroom Verbal Factors

Mathematics Classes (n=9)	
Student Confusion	r=-.69
Student Insecurity of Response	r=-.79
Teacher Interruptive Behaviors	r=-.69
Wait-time	r=.60
Multiple Reinforcement	r=.66
Social Studies (n=4)	
Wait-time	r=.98

*p<.05

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